is simply a convenient way of expressing it in one line; and it is *not* printed as he has misquoted it above.

GEORGE HENSLOW

6, Tichfield Terrace, Regent's Park, N.W.

[I am obliged to my friend Mr. Henslow for correcting my oversight in not accurately noting the form of his formula. The fact, however, that the sentence is, as, Mr. Henslow admits, put in a form which is adapted for "mathematical students only," in a work intended for beginners, seems to furnish a strong justification of the main point of my criticism.—A. W. B.]

Alumina

IT may interest your readers to know that pure alumina dissolved nearly to saturation before the blowpipe in an *acid* flux, such as a bead of phosphoric acid, invariably causes that to assume a pale but beautiful sky blue on cooling.

In an *alkaline* flux such as a bead of boric acid containing sufficient soda to dissolve it to saturation, alumina causes the bead to assume a pale red colour on cooling.

The greatest care has been taken to ascertain that the materials are absolutely free from any metallic or other oxide which might produce such colours, and the resulting beads have been shown to several gentlemen, as Messrs. Hunt and Roskell, Mr. Hutchings of Freiberg, and others.

Might not these facts then afford us some clue (so much wanted) to the cause of coloration in the sapphire and ruby?

London, July 1 W. A. ROSS

A Subject-Index to Scientific Periodical Literature

I HAVE been occupied for years in drawing up a classified index, not only to the titles of papers, but to what is still more wanted, to the facts contained in those papers. As yet I have met with scant encouragement. A. RAMSAY

Kilmorey Lodge, 6, Kent Gardens, Ealing, W., July 8

CLUB-ROOT

ALL our readers who are agriculturists or practical gardeners will be familiar with the disease called in England "Club-root," or "Finger and Toes," or "Clubbing." It seems almost to confine its ravages to cruciferous plants, and often causes great destruction to large crops of turnips, cabbages, cauliflowers, not to mention what disappointments it may occasion to the growers of wallflowers, Brompton stocks, candytufts, and many other favourite flowers belonging to this large natural family. Not only is it well known, but it has often been written about, as the pages of our contemporary, the *Gardeners' Chronicle*, and most works on the cultivation of gardens, will abundantly prove.

The question of what did it consist of was often asked, and the answer was that it was caused by some insect or another, and some poor beetles and flies were signalled out as those which laid their eggs in the tissues of the young roots of the plants attacked, and, if we are not mistaken, this is the general belief to this present moment. The explanation never was, however, satisfactory. True, in the advanced stage of this disease insect larvæ were to be found in the club-like swellings of the roots; but in the very early stages no trace of larva or egg of any insect was to be seen, and yet the club-root disease was clearly there.

In the *Botanische Zeitung* for May 14, 1875, there appeared a short abstract of a paper read by M. Woronin, before the Botanical Section of the Natural History Society of St. Petersburg, on the 5th of March of the previous year, on the cause of this disease, and within the last few weeks we have received the full memoir, illustrated with upwards of fifty figures. This memoir is in Russian, but, thanks to a colleague (Prof. R. Atkinson), the writer has been able to glean a notion of its most interesting contents, in which he has been much assisted by the beautiful figures. The disease is known in Russia as "Kapustnaja Kila" (Kapusta = Cabbage, Kila = Hernia). About three years since it was so extremely prevalent that the vegetable crops about St. Petersburg failed, and the government ordered an investigation, from which much information was obtained as to the means adopted in different countries for its cure: such as sowing the ground, before planting the crop, with common salt, wood ashes, or, before all, soot. Every one knows, too, that in transplanting the young crucifers into their permanent beds that it is customary to pinch off the swollen portions, and then, if favourable weather followed, the newly-formed roots could well keep ahead of any fresh appearance of the disease. But M. Woronin went scientifically to work, and he was not long in discovering that the cause of the disease was a parasitic vegetable which seemed to have some affinities with the Myxomycetes on the one hand, and the Chytridiaceæ on the other, and the result of constant researches carried on through 1875, 1876, and last year, have resulted in nearly the whole life-history of this new plant being discovered. It is called *Plasmidiophora brassicæ*, and is decidedly very nearly allied to the Chytridia, but the new forms of this group daily coming to light, appear so different in their development, that much more must be known about them ere any satisfactory classification can be attempted. One most striking feature in the new plant is indicated by its generic name; this will be best understood by a short history of the plant's life. Take an old well-developed knob off a club-root, and examine the tissue; most of the parenchymatous cells will be found enlarged, their starchy contents gone, and they themselves gorged with a mass of spore-like bodies; by the ordinary disintegration of the cellular tissue these spores will get released, and after a lapse of six days, out of each spore will proceed the whole of the contents, which, colourless, but nucleated, will move about like so many minute amœba; these plasmodia will then attach themselves to the delicate root-hairs of the nearest young cruciferous seedling. One end of the plasmodium is attenuated like a cilium. The spores soon penetrate into the cells, where they will look just like Myxamœbæ. Filling the cells up with delicate plasmodic projections, they will next soon develop lots of spores, which will further contaminate the cellular tissue of the root, and in process of time the formation of the clubbing will be seen.

Sometimes the ripe spores are spherical, sometimes they are twin-like, or lenticular. If cabbage or turnip seeds be sown in a watch-glass and supplied with distilled water, and shortly after the first appearance of germination, a number of spores of *Plasmidiophora brassicæ* be added to the water, these will be found to at first float freely in the water, but sooner or later will sink and attach themselves to the delicate root-hairs of the little seedlings, and in this way their whole history, so far as now known, may with facility be traced. It seems noteworthy that the whole mass breaks into spores all at once, as in Chytridium proper. There would seem to be as yet no conjugation detected, and the plasmodia would appear as if they absolutely engulfed the starch granules on which they feed.

It must be a matter of regret that this memoir is written in a language known unfortunately to so few scientific botanists. If the learned author knew only Russian it would be absurd and unreasonable to record this regret, but to one knowing French and German, as M. Woronin does, it would have been no trouble to have increased a hundredfold the grateful readers of this important memoir.

E. PERCEVAL WRIGHT

SCIENCE IN SCHOOLS

THE following article on Sir John Lubbock's Bill on the introduction of science in elementary schools appears in Monday's *Times*:—

The rejection of Sir John Lubbock's motion for the addition of elementary science, or, rather, as the matter was more happily put by Dr. Lyon Playfair in the course of the debate, of elementary knowledge of common things, to the subjects for which grants are given under the education code, although an inevitable and foregone conclusion, is not on that account the less to be deplored. As happens in many similar cases, the argument was all on the side of the minority, and Lord G. Hamilton, in opposing the suggestion on the part of the Privy Council, was only able to say that its adoption would, perhaps, entail some temporary uncertainty about the subjects in which inspectors would be required to examine and children to pass. If schools existed for the convenience of inspectors, or even in order that children might not be troubled by uncertainties, the objection would have been a valid one; but upon any other supposition it seems to tell against, rather than in favour of, the contention which it was intended to support. The nation is spending large and rapidly increasing sums of money upon schools, and it will every year become a matter of greater urgency that these sums should not be misapplied, either by the omission from the code of subjects which would be useful or by the inclusion of others which have no apparent tendency to promote the attainment of the ends to which education is supposed to be directed. These ends, in the case of a peasant child, are presumably to render him a more useful and a better conducted member of society than he would become by the unaided light of nature; and it is obvious that the means to their attainment are twofold—first, to cultivate the intelligence in such a way as to facilitate the acquirement and the application of knowledge; and, secondly, to impart the knowledge which has to be applied. Until a comparatively recent time, however, the imparting of knowledge was considered to be the sole purpose of education and to be in itself the best means of mental training; so that educationists occupied themselves more about the seed than about the soil, and were chiefly concerned to teach those things which they thought it most important that a child should know. The instruction given to the poor for many years was almost limited to reading, writing, arithmetic, and elementary religious instruction, while that imparted to the rich was laid upon the same foundation, and was only carried further because the pupils had more time at their disposal. In the employment of this time the instructors could only teach what they knew; the most famous public schools and the two great Universities restricted themselves to giving their pupils some knowledge of classics and mathematics.

As soon as physiologists had discovered that all the faculties of the intellect, however originating or upon whatever exercised, were functions of a material organism or brain, absolutely dependent upon its integrity for their manifestation, and upon its growth and development for their improvement, it became apparent that the true office of the teacher of the future would be to seek to learn the conditions by which the growth and the operations of the brain were controlled, in order that he might be able to modify these conditions in a favourable manner. The abstraction of the "mind" was so far set aside as to make it certain that this mind could only act through a nervous structure, and that the structure was subject to various influences for good or evil. It became known that a brain cannot arrive at healthy maturity excepting by the assistance of a sufficient supply of healthy blood—that is to say, of good food and pure air. It also became known that the power of a brain will ultimately depend very much upon the way in which it is habitually exercised, and that the practice of schools in this respect left a great deal to be desired. A large amount of costly and pretentious teaching fails dismally for no other reason than because it is not directed by any knowledge of the mode of action of the organ to which the teacher endeavours to appeal; and mental growth in many instances occurs in spite of teaching rather than on account of it. Education, which might once have been defined as an endeavour to expand the intellect by the introduction of mechanically compressed facts, should now be defined as an endeavour favourably to influence a vital process; and, when so regarded, its direction should manifestly fall somewhat into the hands of those by whom the nature of vital processes has been most completely studied. In other words, it becomes neither more nor less than a branch of applied physiology; and physiologists tell us with regard to it that the common processes of teaching are open to the grave objection that they constantly appeal to the lower centres of nervous function, which govern the memory of and the reaction upon sensations, rather than to those higher ones which are the organs of ratiocination and of volition. Hence a great deal which passes for education is really a degradation of the human brain to efforts below its natural capacities. This applies especially to book work, in which the memory of sounds in given sequences is often the sole demand of the teacher, and in which the pupil, instead of knowing the meaning of the sounds, often does not know what "meaning" means. As soon as the sequence of the sounds is forgotten nothing remains, and we are then confronted by a question which was once proposed in an inspectorial report:—"To what purpose in after-life is a boy taught if the intervention of a school vacation is to be a sufficient excuse for entirely forgetting his instruction?"

In order to avoid such faulty teaching, few agencies are more valuable than what are technically called "object" lessons, in which the faculties of the pupils are exercised about things instead of about words; and the suggestion of Sir John Lubbock would lead to object lessons of a very useful character. To be taught something about gravitation, about atmospheric pressure, about the effects of temperature, and other simple matters of like kind, which would admit of experimental illustration, and which would call upon the learner to make statements in his own words instead of in those of somebody else, would be so many steps towards real mental development. At the end of a vacation, even if the facts of any particular occurrence had become somewhat mixed, the pupils would nevertheless preserve an increased capacity for acquiring new facts, and would probably retain these for a longer period; and such are precisely the changes which it should be the province of education to bring about. We would even go further than Sir John Lubbock, and in elementary schools would give an important place to the art of drawing, which teaches accurate observation of the forms of things. The efforts of a wise teacher should always be guided with reference to the position and surroundings of a child at home, and should seek to supplement the deficiencies of home training and example. Among the wealthier classes the floating information of the family circle often, though by no means always, both excites and gratifies a curiosity about natural phenomena; but among the poor this stimulus to mental growth is almost, if not entirely, wanting. An explanation of the physical causes of common events, such, for instance, as the rising of water in a pump, would usually be a revelation to the pupils of a Board School, and would start them upon a track which could hardly fail to render them more skilful workers in any department of industry, and which might even lead some of them to fortune. A wise and benevolent squire set on foot many years ago a school for the children of his labourers, in which drawing and the elements of natural science were carefully taught; and the result was that the children educated there, instead of remaining at the plough's tail, passed, in an astonishingly large number of cases, into positions of

responsibility and profit. On every ground, therefore, we hope that Sir John Lubbock's proposal will at no distant time be adopted by Parliament; but in the meanwhile there is a still more important department of teaching which is wholly neglected, and concerning which the deficiencies of home instruction are at least equally manifest. We refer to a proper knowledge of the influence of conduct upon life. It should be the duty of every schoolmaster to try and make his pupils understand how production—that is to say, industry—leads to wealth, and how destruction—that is to say, idleness—leads to poverty. The reason why confidence in others is necessary to all enterprise, and the reason why honesty, in the largest sense of the word, is the only root of confidence, should in like manner be enforced by precept and illustrated by example; and such teaching, if it could only be made general, would do more to heal the breach between capital and labour than all the panaceas of all the politicians who have ever sought to figure as the "friends of the working man."

OUR ASTRONOMICAL COLUMN

TEMPEL'S COMET, 1873, II.—Up to the time of writing it would appear that this comet has escaped detection. Even if there be no great error in the calculated position, its faintness must render discovery difficult in the summer skies, but it may be hoped nevertheless that a vigorous effort will be made in the next period of absence of moonlight to recover the comet, as in the event of want of success in the present year, it will be probably lost, or in the same case as the short-period comet of De Vico of 1844, which, being missed at the second return in 1855, has not been again observed. M. Schulhof has communicated to the French Academy a further ephemeris of Tempel's comet, from which are extracted the places subjoined:—

At Paris midnight.	R.A. h. m.	N.P.D. ° ′	At Paris midnight.	R.A. h. m.	N.P.D. ° ′
July 13	15 31·6	93 18	July 29	15 47·6	100 8
,, 17	15 34·4	94 55	Aug. 2	15 53·8	101 57
,, 21	15 38·0	96 36	,, 6	16 0·8	103 46
,, 25	15 42·4	98 21	,, 10	16 8·6	105 36

During this interval the comet's theoretical intensity of light will be only three times that it possessed at the date of the last observation in 1873, when it was the faintest object that could be observed in a dark field with a 7-inch refractor. A few days' difference in the date of perihelion passage, which is probable enough, changes the geocentric path materially, so that the search must be extended to some distance on each side of the calculated place for the day of observation.

In its present orbit the comet cannot approach the planet Jupiter within 0·62, and with M. Schulhof's period of revolution it is easy to see that there will be no near approximation of the two bodies during the next twenty years—in such case the perihelion passages must always occur at a season of the year when observations of the comet would be barely, if at all, practicable. Hence an additional reason for a very close search in the present summer.

THE "TEMPORARY STARS" OF KEPLER AND ANTHELM.—The objects observed by Kepler in 1604 and by Anthelm in 1670, which Sir John Herschel was wont to describe as "temporary stars," but which there is, nevertheless, reason to believe to be still visible as telescopic stars, will not escape the attention of observers who are interested in the variables, at this season. As mentioned some time since in this column, Prof. Winnecke remarked, in 1875, a star of the twelfth magnitude on his scale, which is very near the calculated place of Kepler's famous star, and to the place of a star entered upon Chacornac's Chart, No. 52, as a *tenth* magnitude. We are able to state that no star was discernible in this position with 7-inches aperture on several occasions in 1872-74. The position of Winnecke's star for 1855·0 is in R.A. 17h. 21m. 49·3s., N.P.D. 111° 19′·3; it therefore precedes No. 16,872 of Oeltzen's Argelander by 33s. and is north of it 2′: Argelander's star is of 8·9m. and the best reference point in examination of the neighbourhood. For 1870·0 we have:—

	R.A. h. m. s.	N.P.D. ° ′	
Kepler's star 1604	17 22 51	111 22·0	Schönfeld's reduction from observations of Fabricius.
Chacornac's star 10m.	17 22 43	111 22·5	Read off from his chart, therefore only approximate.
Winnecke's star 12m.	17 22 43	111 20·8	Observed at Strasburg.
Argelander's star 8·9m.	17 23 16	111 22·8	

There is also a star of about 12m. in R.A. 17h. 22m. 57s., N.P.D. 111° 24′·4, and therefore as near to the calculated position of Kepler's star as Winnecke's object, which has not shown any variation during several years. The difference of magnitude noted by Chacornac and Winnecke rather points to their star as the one to be closely watched.

The place of the star discovered by Anthelm in 1670 has been calculated from the observations of Picard and Hevelius by Prof. Schönfeld, and from those of Picard only (as given in the *Histoire Céleste* of Lemonnier) by Mr. Hind, their results differing only 2s. in R.A., and 0′·4 in N.P.D. The telescopic star 11·12m., which is now visible almost in the same position, was meridionally observed at Greenwich in 1872, the result for 1880·0 being R.A. 19h. 42m. 45·1s., N.P.D. 62° 58′ 32″. Variation extending to more than one magnitude has been remarked in this object, during the last twenty-five years, thus, with the near coincidence of position affording strong indication that it may eventually prove to be the star which suddenly brightened up in 1670. A star of similar magnitude follows it 12·5s., about 3′ to the north, and another follows at 22·5s., about 2′ northerly. In the years 1872-74 the presumed star of Anthelm was judged to be at times sensibly equal to the first of these stars following it, at others decidedly fainter—even at the first glance.

JEREMIAH SHAKERLEY.—The transit of Mercury on November 2, 1651, it will be remembered, was predicted by Jeremiah Shakerley, a young devotee of astronomy, who, finding by the tables in his hands, apparently founded upon the observations of Horrox, that it would not be visible here, undertook the, at that period, great voyage to India for the purpose of witnessing the phenomenon, which he observed at Surat. Vincent Wing mentions this circumstance in his *Astronomia Britannica*, where the following passage occurs:—"Hanc conjunctionem prædixit idem D. Shakerlœus in *Colloquio* seu *Disceptatione, De Mercurio in Sole Videndo*, et postea ipse transmigrans in *Indiam*, conjunctionem hanc insignem ibi videbat, eamque amicis in *Anglia* communicavit, ut patet ex Literis ad *Christophorum Townlœum, Henricum Osbornum, Londinensem*, aliosque missis."

No work of Shakerley's exists in the libraries of the British Museum, the Royal Observatory, or the Royal Astronomical Society. His *Tabulæ Britannicæ* are in the possession of the Royal Society, and we believe are also found in the Cambridge University Library. The immediate object of this note is to inquire if any reader of NATURE has met with the other works of Shakerley mentioned by Lalande in his *Bibliographie*, or with a publication in which the transit of Mercury in 1651 was predicted.